

# Performance Measurement of Logistics Processes

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## Abstract

The purpose of this paper is to introduce and describe an approach to performance measurement of logistics processes. The paper has four main parts. First, an introduction to performance measurement is provided. Then, a performance improvement framework is presented. Third, a new improvement oriented model is outlined. In order to illustrate the approach, text-based and number-based measures for three logistical processes are provided. Finally, the suggested approach is compared with performance measurement and balanced scorecard.

Keywords : Performance Measurement, Performance Improvement, Self-assessment, Logistics

## 1 PERFORMANCE MEASUREMENT

Productivity in a narrow sense has been measured for several years. In 1978 an enlarged method, the POSPAK method, was introduced. This method indicates specific measures in order to improve the overall productivity of an enterprise (Sjøborg, 1984). One of the first approaches to performance measurement was published by Sink and Tuttle (Sink, 1985, Sink and Tuttle, 1989). The model claimed that the performance of an organizational system is a complex interrelationship between seven criteria. In 1993 Hronec published the book "Vital Signs", where he described how to use quality, time, and cost performance measurements to chart the company's future. In 1995 Rolstadås edited the book "Performance Management". It sought to provide the reader with a detailed overview of the modern enterprise by focusing on performance evaluation and measurement and performance improvement techniques. Since 1995 a number of books and papers on performance measurement and management have been published.

One example of a performance measurement system is the TOPP system, which was developed by SINTEF (Moseng, 1996) in Norway in partnership with the Norwegian Institute of Technology (NTH), the Norwegian Federation of Engineering Industries (TBL), and 56 participating enterprises. The TOPP system views performance

along three dimensions (Moseng and Bredrup, 1993). These are illustrated in Figure 1.

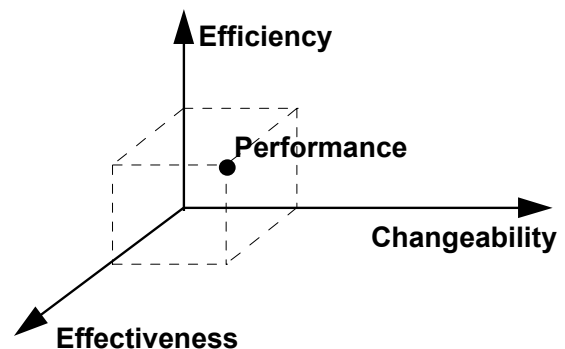


Figure 1 Performance measurement (Moseng and Bredrup, 1993)

1. Effectiveness - satisfaction of customer needs.
2. Efficiency - economic and optimal use of enterprise resources.
3. Changeability - strategic awareness to handle changes.

In TOPP a number of performance measures were developed based on these dimensions.

One example of a recent performance measurement system is the ENAPS (European Network for Advanced Performance Studies) performance measurement system, developed in the EU financed project ENAPS. This was based on a number of performance measurement systems

and recent research. The ENAPS business model is shown in Figure 2 and reflects a future view of a manufacturing enterprise as it incorporates the end of life use of products (Andersen, Rolstadås, and Fagerhaug, 1998). Based on this business model, ENAPS has suggested three levels of hierarchy for defining performance indicators. Each performance

indicator is a function of two or more performance measures. The three levels of hierarchy for defining performance indicators are: "Enterprise Level", "Process Level" and "Function Level". The performance measures used in calculating these performance indicators are measured from all over the enterprise (Andersen et al., 1998).

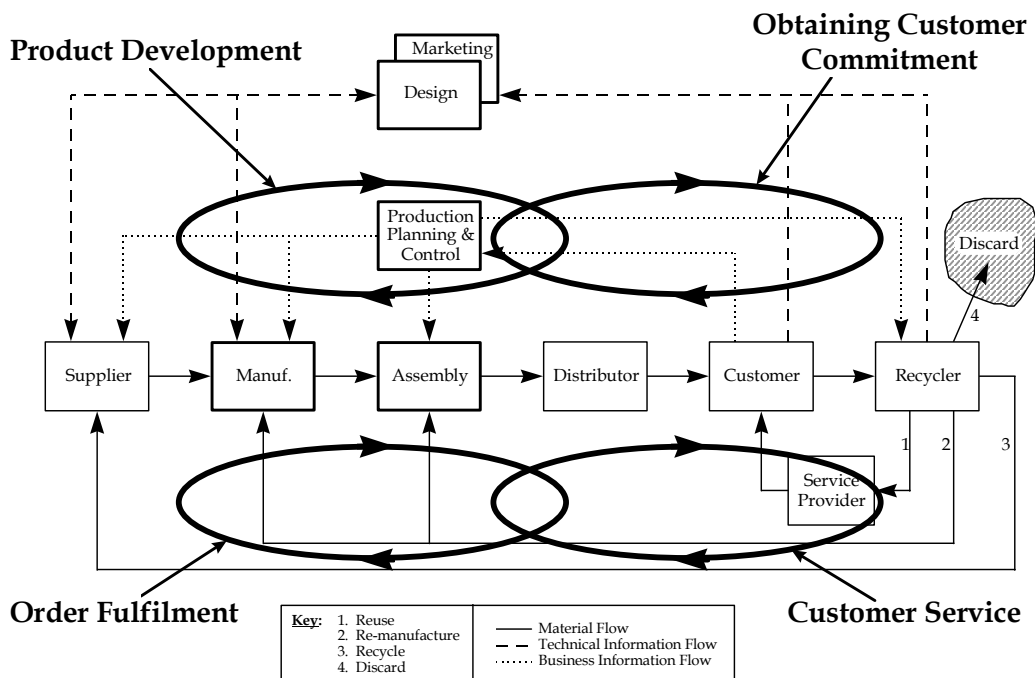


Figure 2 The extended ENAPS business model (Andersen et al., 1998)

## 2 A FRAMEWORK FOR IMPROVEMENT

Performance measurement plays an important part in a performance improvement framework. An example of such a framework is illustrated in Figure 3. This framework is cyclic, and based on the Plan-Do-Check-Act principle of the Deming wheel.

The first phase in the cycle is self-assessment. The European Foundation for Quality Management – EFQM (1998) has described self-assessment as a comprehensive, systematic and regular review of an organization's activities and results referenced against a model of business excellence. EFQM emphasize that the self-assessment process allows the organization to discern clearly its strengths and areas in which improvements can be made and

culminates in planned improvement actions which are then monitored for progress.

Based on the self-assessment, improvement planning should be performed. Then improvements should be initiated. As illustrated, a number of tools can be utilized in order to improve the performance of organizations, e.g., streamlining, benchmarking, business process reengineering (BPR), statistical process control, and root cause analysis.

Through performance measurement, the various performance level of the business should be monitored. As shown in the figure, performance measurement provides input for the improvement planning, choice of improvement tools, as well as for the self-assessment process.

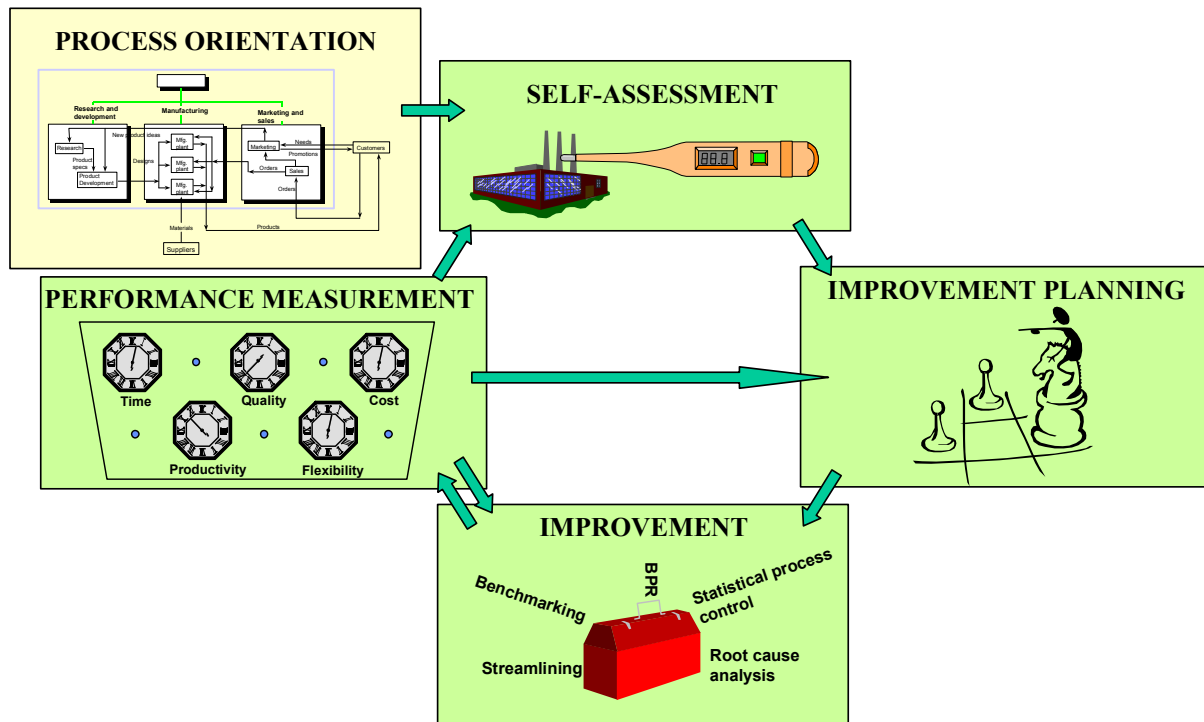


Figure 3 A performance improvement framework Andersen, 1998)

The figure also illustrates that process orientation is important input in such a framework. Andersen (1999) has argued that several issues have stressed the logic of the transition from viewing the company as a number of departments to focusing on the business processes being performed:

- Every process has a customer, and focusing on the process ensures better focus on the customer.
- The value creation with regard to the end product takes place in horizontal processes.
- By defining process boundaries and the customers and suppliers of the processes, better communication and well-understood requirements can be achieved.
- By managing entire processes that run through many departments rather than managing individual departments, the risk of suboptimization is reduced.
- By appointing so-called process owners, who are responsible for the process, the traditional fragmentation of responsibility often seen in a functional organization is avoided.
- Managing processes provides a better foundation for controlling time and resources.

Many of these elements are based on the fact that every single process has both a supplier and a customer. What are then business processes? In this paper Ericsson's (1993) business process definition is chosen:

- A chain of logical connected, repetitive activities that
- utilizes the enterprise's resources to
- refine an object (physical or mental)
- for the purpose of achieving specified and measurable results/products for

- internal or external customers.

A main point is that any business process has a customer, either external or internal. Based on this definition, almost all activities within a company can be seen as a business process or part of a business process, including the processes related to logistics.

### 3 A NEW IMPROVEMENT ORIENTED MODEL

There are a number of ways of classifying business. In the current paper it has been chosen to use the classification suggested by Fagerhaug (1999), which is based on a self-assessment approach. He suggested that the following five types of processes/structures could be used when classifying the processes of a business:

- Primary processes. The value-adding processes commonly found in any organization, often labeled main processes.
- Secondary processes. Processes supporting the execution of the primary processes. These are often labeled support processes.
- Development processes. Processes aimed at improving the organization's performance, for instance new product development.
- Structural factors. Innate characteristics of the organization, for instance resources.
- Stakeholders. The stakeholders are the parties that can affect or are affected by the degree of achievement of an organization's purpose.

Figure 4 shows a business mode based on the five types of processes/structures (Fagerhaug, 1999).

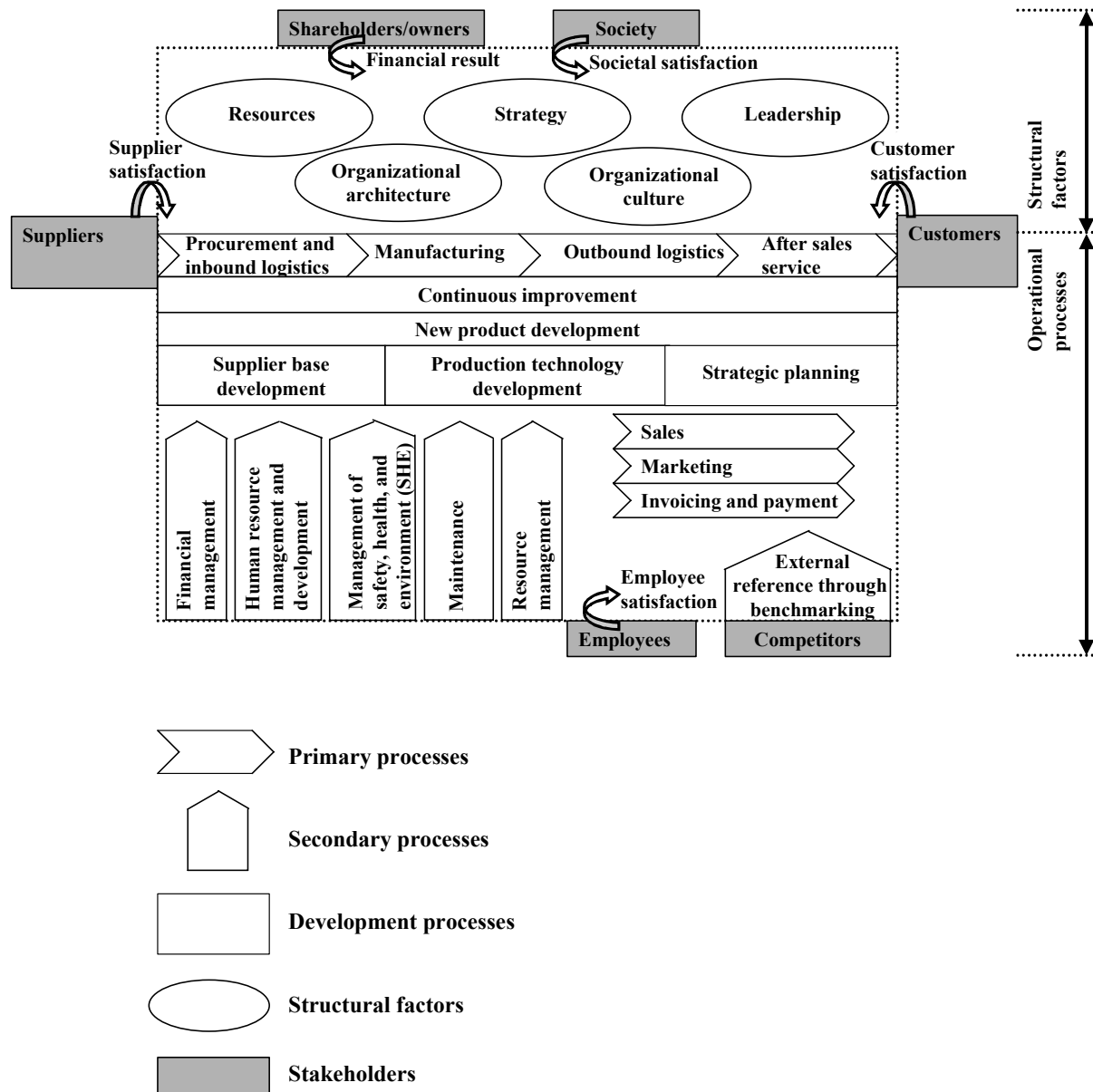


Figure 4 A business model (Fagerhaug, 1999)

When describing and measuring the performance level in a business process, a number of parameters might be used. It is pivotal to employ a balanced set of measures in order to understand the performance of the process and be able to identify improvement areas. Typical dimensions for describing and measuring performance are (Fagerhaug, 1999):

- Qualitative and quantitative measures.
- “Hard” versus “soft” measures.
- Financial versus non-financial measures.
- Result versus process measures.
- Measures defined by their purpose (result, diagnostic, and competence).
- Efficiency, effectiveness, and changeability.
- The six classic measures (cost, time, quality, flexibility, environment, and ethics).

All areas should be considered when developing performance measures. It should be emphasized that these dimensions overlap. In order to diagnose the “health status” of an organization one should

ideally employ a balanced combination of measures.

Fagerhaug (1999) divided the criteria for each business process into two main dimensions; measures defined according to purpose (result measure, diagnostic measure, and competence measure), and whether they are qualitative or quantitative. The reason is that the measures defined according to purpose indicate different time periods. The result measures indicate something about the past and partly about the present. The diagnostic measures say something about probable evolution in the short run, as well as something about the present. Competence measures indicate something about possible future development.

Three by two categories would add up to six categories. However, qualitative result measures are infrequent, and thus the following five areas are selected:

- Quantitative result measures.
- Qualitative diagnostic measures.
- Quantitative diagnostic measures.
- Qualitative competence measures.

- Quantitative competence measures.

For each of the 28 processes/structures, Fagerhaug (1999) has developed a criteria sheet. The sheet provides the name and a short description of the process/structure, as well as a number of text-based and number-based measures belonging to each of the five categories mentioned above. It should be emphasized that the measures are examples rather than a final set.

The authors of this paper would argue that a number of these processes/structures could be used to enhance the performance of the business' logistics processes. One could argue that the business should keep all five dimensions (types of processes/structures) in mind when seeking to improve their performance, e.g., that stakeholders also should be taken into consideration when focusing on primary processes.

In order to illustrate the suggested approach, text-based and number-based measures for three

logistical processes can be found on the consecutive pages. The choice of the three processes/structures was based done to illustrate different aspects of the approach. Table 1 shows the primary process Procurement and inbound logistics. Table 2 illustrates the development process supplier based development. While the first is a more operative process, the latter is aimed a improving the organization's performance in the supplier related area. Table 3 depicts the stakeholder Customers. While the different types of processes have a number of different dimensions, the stakeholders are more limited, e.g., competence measures for customers are of little value for the organization.

The three sheets are enclosed as examples of the approach. Detailed description of the approach, including all 28 processes/structures can be found in Fagerhaug (1999).

PRIMARY PROCESSES

A1 Procurement and inbound logistics

Procurement consists of all the activities related to obtaining products or services to a production unit, to a service provider, or to a trading partner's stock, while inbound logistics concerns the associated flow of information and goods up until the product or service has reached the organization.

Specific measures for the process

	Result measures	Diagnostic measures	Competence measures
Qualitative		<p>Use a flow chart or another visualization technique to describe the flow in the chosen process. Keep focus on the main flow of products/services, and on the associated information flow. Describe the process' customers and suppliers, as well as important external conditions.</p>	<ul style="list-style-type: none"> <li>Describe how it is assumed that the process will be done 5 years into the future. Keep focus on the differences from the current process.</li> <li>Describe how it is secured that the process is continuously developing, and how creativity/innovation is maintained.</li> <li>Describe the process' ability to adjust to external conditions.</li> <li>Describe the organization's strategy for training and continuous education for those engaged in the process.</li> <li>Describe how the organization monitors similar processes in other organizations.</li> </ul>
Quantitative	<ul style="list-style-type: none"> <li>Total costs incurred through performing the procurement and inbound logistics activities as a percentage of the overall turnover.</li> <li>Percentage increase/decrease in price as against price for comparable products or services.</li> </ul>	<ul style="list-style-type: none"> <li>Average delivery time from suppliers.</li> <li>Average purchase value from each supplier.</li> <li>Ratio bought from suppliers that the organization has frame agreements with.</li> <li>Incoming delivery quality.</li> <li>Incoming delivery completeness.</li> <li>Incoming delivery timeliness.</li> <li>Dependability of the most important suppliers.</li> <li>Number of suppliers.</li> <li>Turnover of inventory.</li> <li>Total value of inventory.</li> </ul> <p>Are there any other measures that describe how well the process is performing? These might be measures dealing with time, quality, cost, flexibility, environment, the process itself, the results of the process, soft measures, etc. List these and their values.</p>	<p>Describe relevant quantitative competence measures, such as:</p> <ul style="list-style-type: none"> <li>Resources used on internal training of personnel working in the process [% of overall turnover].</li> <li>Resources used on external training of personnel working in the process [% of overall turnover].</li> <li>Ratio of the work in the process which is conducted in teams [average percentage of the day spent working in teams].</li> <li>Investments in systems and resources for procurement and inbound logistics [percentage of overall turnover. List values for last 3 years].</li> </ul>

Table 1 Procurement and inbound logistics (Fagerhaug, 1999)

DEVELOPMENT PROCESSES

C3 Supplier base development

Supplier base development covers all efforts to develop relationship to existing suppliers and obtain new suppliers.

Specific measures for the process

	Result measures	Diagnostic measures	Competence measures
Qualitative		Use a flow chart or another visualization technique to describe the flow in the chosen process. Keep focus on the main flow of products/services, and on the associated information flow. Describe the process' customers and suppliers, as well as important external conditions.	<ul style="list-style-type: none"> <li>Describe how it is assumed that the process will be done 5 years into the future. Keep focus on the differences from the current process.</li> <li>Describe how it is secured that the process is continuously developing, and how creativity/innovation is maintained.</li> <li>Describe the process' ability to adjust to external conditions.</li> <li>Describe the organization's strategy for training and continuous education for those engaged in the process.</li> <li>Describe how the organization monitors similar processes in other organizations.</li> </ul>
Quantitative	<ul style="list-style-type: none"> <li>Number of suppliers.</li> </ul>	<ul style="list-style-type: none"> <li>Supplier turnover.</li> <li>Ratio of supplier assessment [number of suppliers which the organization has assessed divided by total number of suppliers].</li> <li>Ratio of assessment of new suppliers.</li> <li>Frequency of mapping of the supplier market.</li> <li>Frequency of meeting with suppliers.</li> <li>Extent of active use of supplier data.</li> </ul> <p>Are there any other measures that describe how well the process is performing? These might be measures dealing with time, quality, cost, flexibility, environment, the process itself, the results of the process, soft measures, etc. List these and their values.</p>	<p>Describe relevant quantitative competence measures, such as:</p> <ul style="list-style-type: none"> <li>Resources used on internal training of personnel working in the process [% of overall turnover].</li> <li>Resources used on external training of personnel working in the process [% of overall turnover].</li> <li>Ratio of the work in the process which is conducted in teams [average percentage of the day spent working in teams].</li> <li>Investments in systems and resources for supplier based development [percentage of overall turnover. List values for last 3 years].</li> </ul>

Table 2 Supplier base development (Fagerhaug, 1999)

## STAKEHOLDERS

### E5 Customers

Describe the organization's customers, as well as the major interfaces between the customers and the organization. Assess the following areas:

- Number of customers.
- Turnover.
- Dependability of most important customers.
- Possible "substitute" customers (meaning customers that might buy the organization's products or services if the original customers cease doing so).
- Demanding customers.
- The customers' division into market segments (geographical).
- Are the customers mainly consumers or professional customers.
- The customers' purchasing power.
- The customers' expectations from the organization.
- The customers' requirements from the organization.
- The customers' contributions to the organization.
- The customers' ability to meet future changes (adaptability).

Are there any other measures that describe the organization's customers, as well as the major interfaces between the customers and the organization? These might be measures dealing with time, quality, cost, flexibility, environment, etc. List these and their values.

Table 3 Customers (Fagerhaug, 1999)

## 4 COMPARISON

What are then the differences and similarities between the described approach, which is based on a self-assessment foundation, and tools like performance measurement and balanced scorecard?

### 4.1 Comparison of performance measurement and self-assessment for business excellence

What is the difference between a "traditional" measurement system and self-assessment? Because of the many definitions and meanings of self-assessment, this difference is not altogether evident, but some differences are (Bredrup, 1995):

- When to measure. In the traditional measurement system the measurement is continuous. In self-assessment the measuring is done at certain times, with an interval between the measurements.
- Focus. A traditional measurement system measures in detail within one or more departments or processes. Self-assessment is, however, more focused on a somewhat superior and holistic image of the company.
- Use. Data from the traditional measurement system are used in the day-to-day control and measurement of improvements. Self-assessment is, nevertheless, used in a greater degree to define more long-term focus areas for improvement and for strategic decision support.

#### *Philosophy*

Both methods focus on assessing the current state of the organization or parts of it. Both methods are aimed at improving the organization.

Self-assessment for business excellence is a method that can be employed at certain intervals, for instance annually, while performance measurement is usually a continuous process. However, one performance measurement may also be used for short periods of time. An example is a group of employees in a travel agency who wants to improve their performance. By measuring key characteristics of their processes for a limited time they might learn enough to initiate minor improvement efforts.

#### *Process or approach*

Traditional performance measurement systems are more focused on the results than the processes. Imai (1986) labeled these Process-Oriented Criteria (P criteria) and Result-Oriented Criteria (R criteria). R criteria are the easiest to measure, and focus on areas that traditionally have been addressed in USA. Here we can draw a parallel to Deming (1986), who had "Management based on highly visible performance measures" as one of his five deadly diseases. Fellers (1992) supported Deming's work and advocated a process view. In self-assessment for business excellence the focus is both on the results as well as the processes.

A major difference between traditional performance measurement and self-assessment for business

excellence is the type of data collected and used: In performance measurement the data are mostly quantitative and focused on operational issues. In self-assessment for business excellence the data are both qualitative and quantitative, and they have a longer time perspective than those used in performance measurement.

The data collected in a traditional performance measurement system are thus of limited value in the self-assessment process. A similar conclusion is reached if one looks at the performance dimensions from Harrington (1991) and TOPP (Moseng and Bredrup, 1993) illustrated in Figure 1. The traditional performance measurement system is mostly centered on the efficiency part of this cube, while self-assessment for business excellence has to take all dimensions into account, in addition to focus on a higher level.

Many of the same tools can be applied when using both methods, for instance tools for collection, analyzing, and presenting data.

#### *Organizational and detailing level*

Both self-assessment for business excellence and performance measurement are holistic-focused methods. Depending on how they are applied, both concepts are more or less focused on improvement.

In self-assessment employee participation is vital. This is not equally important in performance measurement, especially if the performance measurement system is implemented and fully operational.

### 4.2 Comparison of balanced scorecard and self-assessment for business excellence

#### *Philosophy*

Both methods aim at assessing the current state of the organization or parts of it. Balanced scorecard is, however, monitoring the organization continuously, while self-assessment can be applied at certain intervals, for instance annually. The improvement focus is more evident in self-assessment than in balanced scorecard, as determining areas for improvement is a major part of self-assessment.

#### *Process or approach*

Both methods make use of a reference model, and in self-assessment a business excellence model is used. In balanced scorecard the model which is compared against consists of four areas (Kaplan and Norton, 1996).

Balanced scorecard is a continuous process, as opposed to self-assessment that can be utilized at certain intervals.

The organizations should collect data and analyze them in order to understand their own operations. The data collecting in self-assessment for business excellence consist of both qualitative as well as quantitative data. In balanced scorecard only quantitative data are collected.

#### *Organizational and detailing level*

Both self-assessment and balanced scorecard are holistic-focused methods. The main focus,

however, differs. Self-assessment emphasizes improvement, while balanced scorecard is focused on status. One could label it a state-of-the-art performance measurement tool, incorporating both financial and non-financial measures. Employee participation is thus not as pivotal to balanced scorecard as it is to self-assessment.

## 5 CONCLUSIONS

This paper has sought to give an introduction to a new approach for measuring and improving performance of logistics processes. In order to describe the approach, an introduction has been given to performance measurement. A performance improvement framework has also been introduced. In addition, the approach has been compared with performance measurement and balanced scorecard. We would argue that the use of the approach would enhance the performance of logistics processes.

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